Accelerator Systems Division Highlights for the Week Ending January 10, 2003

ASD/LANL: Warm Linac

HIGH-POWER RF (WBS 1.4.1.1)
Accomplishments this week: (1). LANL staff was at the SNS site to assist ORNL in installation and operation. Our next scheduled visit will follow conclusion of Front End System commissioning and plumbing modifications on the DTL-1 and DTL-2 systems. At that time we will help complete final cabling on DTL-1 and DTL-2, set up and test the interlocks on these systems, and perform an integrated system test by operating these klystrons into a short circuit on port 2 of the circulator. (2) We received first Thales 5 MW, 805 MHz klystron. Crate has been opened, ion pump has been powered up, and the tube appears to have come through shipment in good condition.
Concerns & actions: (1) E2V (Marconi) representatives were at LANL to investigate the 402.5-MHz, 2.5-MW klystron problems related to the brass gasket that holds the center conductor centered in place at the T-bar transition. S/N 007 gasket was ok; S/N 006 - gasket had a groove, halfway around, on RF side (replaced with new gasket). (2) We also showed the E2V representatives that klystron S/N 007 has a vacuum leak. Tube failure is inevitable, so it will be returned to E2V for repair. No impact on the SNS commissioning schedule is forecast from this rework. (3) While at ORNL we made recommendations on the maintenance schedule for cleaning the klystron cooling air filters.

HIGH-VOLTAGE POWER CONDITIONING (WBS 1.4.1.2)
Accomplishments: (1) We received water panel, ground weldment, and safety enclosure for a production HV converter modulator (HVCM) from Dynapower. Ground weldment was installed and connected to building earth ground. Safety enclosure was been installed. Work was initiated to install the water panel. (2) IGBT testing continues with LANL designed diagnostics to determine "Dynamic Saturation" characteristics. Diagnostics show IGBT's act as a fast, saturating switches without long dynamic saturation turn-on time. This result is important for calculation of switching losses and system performance.
Concerns & Actions: (1) Progress was made in returning the prototype HVCM system to operation. Permits and procedures were approved by LANSCE and SNS to enable troubleshooting of 13-kV switchgear. Modeling of the substation fault modes and how it affects the distribution grid continues and show no significant issues.

DRIFT-TUBE LINAC (WBS 1.4.2)
Accomplishments: (1) Water channel e-beam welds were completed on all 54 rebuilt DTL Tank-1 drift tube bodies (Fig. 1), a week ahead of schedule; units are at Coronado Machining (CMI) for follow-on manufacturing. (2) CMI completed finish profile machining of all 7 repaired Tank-1 drift tubes, more than a week ahead of schedule. Final inspections by the vacuum and physics team are underway. (3) All weld preparation and repair rings for all but three Tank-3 drift tube repair welds are complete. All weld repair qualifications are complete. Weld repair of real drift tubes is underway, with 12 (of 29) completed. Typical throughput is 4 repairs per day. (4) Repaired iris/RL waveguide for Tank-3 is complete except for final machining of window-side flange. (5) Rough machining and inspection are complete on Iris/RL waveguide for Tank-1; unit is at plating shop. (6) Salvaged Tank-3 brazing trial Iris/RL wave guide unit has been inspected and deemed satisfactory for use as a Tank-3, 4, 5, or 6 unit; rough machining will commence to prepare it to become the unit for tank four. (7) Rough machining started on replacement 304 stainless steel Tanks-3 and 1 drift tube mount ("top hats").
Concerns & Actions: We generated a nonconformance report on drift tube 3-33 and sent it to the vendor for a corrective action plan where we expect them to implement a standard shipping inspection system with a map or diagram marking dings on each shipped part. A follow-up visit with the vendor is forthcoming. Parts shipped to the e-beam welding house that arrived on 1/9/03 were accompanied by inspection documentation.

Fig. 1: Some Tank-1 drift tubes after e-beam water channel welds.

COUPLED-CAVITY LINAC (WBS 1.4.4)
Accomplishments: (1) Design of the waveguide transition flange was fixed with ACCEL. During our Dec visit, we discussed flange thickness issues and the required number of bolts. We decided to manufacture flanges using both our recommended thicker flange and ACCEL's recommended larger number of bolts. This doubles security and covers all possible concern about adequate seal compression in the CF-type flange.
Concerns & Actions: Vacuum leak through one endplate flange was determined to be caused by the faulty copper plating on the bridge coupler interface flange. It will be reused by machining the entire stainless steel flange away and re-brazing the unit with a new one. There have been no additional indications of leaking in other flanges on hand. Four additional flanges were delivered today, after a heat run at 800°C (standard quality test process for all plated parts) and a successful leak test. In addition, ACCEL re-tested flanges used in construction of the completed bridge coupler S/N 1 to check taped holes. Both flanges are leak tight. ACCEL is continuing with the production while testing the next endwall flanges before the brazing step. The revised plating process with a pulsed power source appears to have corrected the issues with the copper plating on the large stainless flanges. The quantity of completed segment half-cell assemblies waiting for endwalls and tuning is substantial. The rate of stack brazing will be high once the endwalls become available and the tuning and stack brazing can resume.

LINAC PHYSICS (WBS 1.4.5)
Accomplishments: (1) Features were added to the PARMILA code to facilitate studies based on transverse acceptance. This enables to solve two problems: (a) Earlier studies showed that all partially chopped beam bunches lie within the acceptance of the DTL. We are now looking into the possibility that the linac acceptance does not completely shadow the HEBT collimators. (b) A proposed modification to PMQ drift tube design calls for relaxing the tolerance on longitudinal positioning of the PMQ lenses. This new feature will allow us to investigate statistically the possible reduction on DTL acceptance related to this change.
(2) Proposals were made to simplify the design of drift tubes with a split bore tube. *Superfish* studies show that there are no adverse heating effects due to the proposed change.

ASD/JLAB: Cold Linac

Cryomodule M-1 assembly continues with alignment, installation of tuners, process helium piping and inner multi-layer insulation. See photo.

Figure 1 Production Cryomodule M-1 in Assembly.

One of the three cavities for cryomodule M-2 has been qualified. Qualification of the second cavity is scheduled to take place today, and the third will be tested over the weekend.

Three cavities for cryomodule M-3 have been inspected, heat-treated and are ready for helium vessel attachment. Three cavities for M-4 have been inspected and heat-treated. Cavities for M-5 and M-6, as well as one cavity for M-7, are on hand and have passed incoming inspection. Vendor production is proceeding smoothly.

Operation of the electropolish cabinet has been held up by minor electrical wiring problems with the power supply and acid pump. These are understood and corrections are either underway or complete. Approval for operation has been obtained from the local Sanitation District.

The vendor visit to repair the eddy current scanner took place this week. A number of problems were identified and addressed, none of which indicate a problem with the existing data set. One fault requires replacement of an electronic component, which is expected to be delivered and installed next week.

ASD/BNL: Ring

A contract for the 26S26 (8) high field sextupole magnets has been awarded to Alpha Magnetics, located in California.

Low Field Power Supplies - Danfysik reported that they are experiencing capacitor failures on the LFPS electronic boards. The problem appears to be related to marginally sized capacitors on the 50V buss. BNL engineers are working with Danfysik to address this production issue for all remaining factory units and develop a plan for field modifications to those that have already been shipped to Oak Ridge.

Bob Lambiase and Alex Zaltsman will travel to Danfysik this weekend to witness acceptance testing of the 1st article RF Tune PS. While there, Bob will also address production issues related to the Low Field Power Supplies.

Jon Sandberg is going forward with a proactive plan to assist IE Power (Canada) with the mitigation of noise and ripple observed on the read-back signals of the first article Medium Field Power Supply. Jon plans to send an engineer and a technician to IE Power in two weeks to help them resolve the few remaining open issues prior to their start of production (q ~ 80).

The first article injection kicker magnet was measured with satisfactory results for time response and field uniformity. The time response meets required 200 us, and the vacuum chamber was found to have negligible effect to the field variation.

Collimators: Design work continues on the momentum collimator and the Ring primary collimator. Efforts are underway to obtain “as built” facility drawings and tray/piping designs for the HEBT momentum dump alcove.

The field quality of nineteen (19) 27CDM30 correctors has been fully measured. We will pause measurements on the remaining magnets in order to resume measurements of the repaired (water fittings) 21Q40 magnets, as required to support our half-cell production plan.

36CDM30 – the repaired 1st article (NETC) was found to have a mis-wired jumper connection. The problem has been corrected and the magnet is being s/u and prepared for production acceptance.

Half-cells – assembly of unit #2 is IP. Water flow measurements will be included in final testing. Our plan is to ship this next unit to Oak Ridge in February.

We await the arrival of the last six (Phase I) 21Q40 production magnets. These magnets were shipped to BNL in mid December. Tesla reported that all materials needed for Phase II production are in house.

ETC efforts are underway for all Ring sub-systems.

Our comments on the proposed Risk Analysis Format have been sent to the SNS/Project Office.

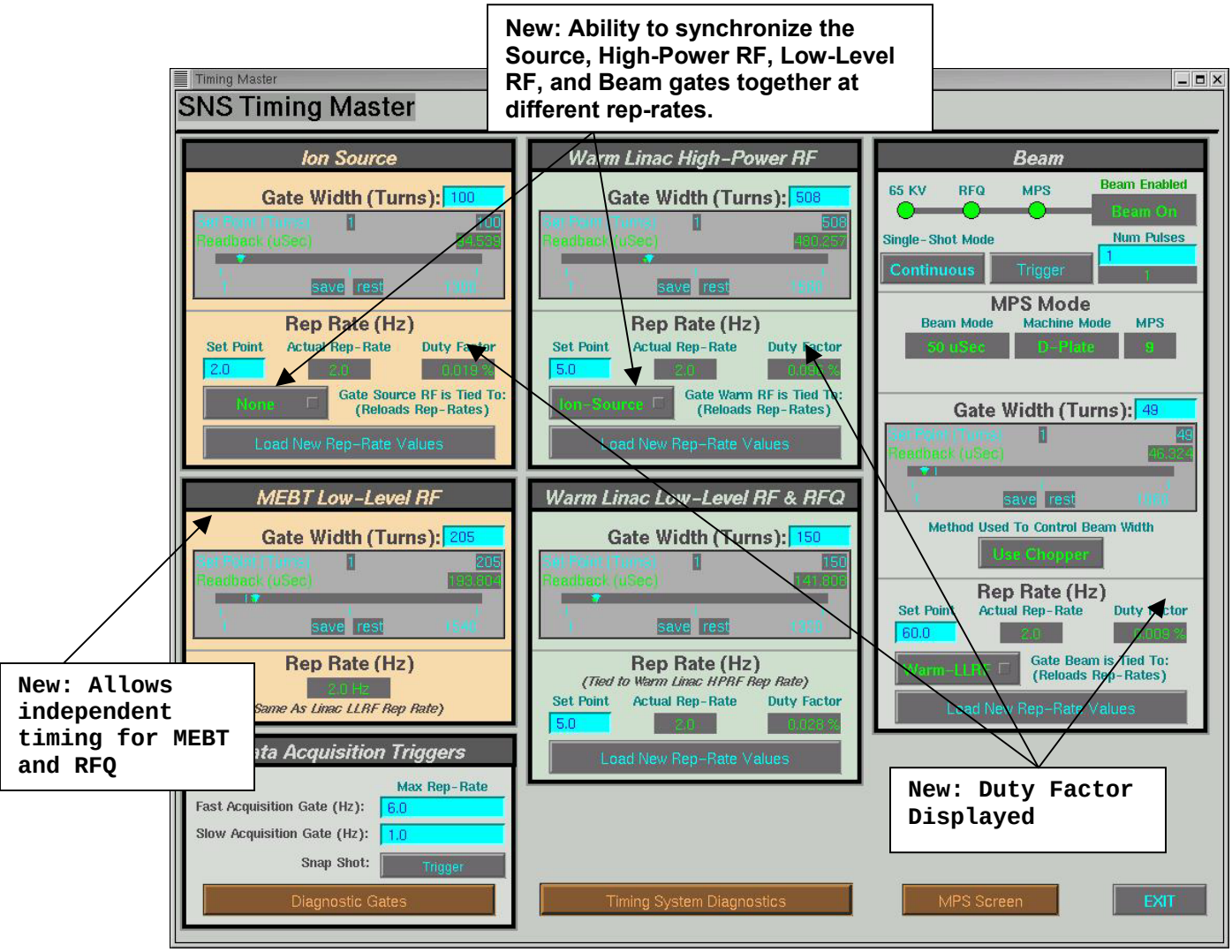
Continuing our support to the SNS front end commissioning, Larry Hoff (Controls Group) participated in the commissioning at ORNL and the BNL/SNS Diagnostics Group is working to repair beam-current-monitor electronic boards damaged during commissioning.

Preparations are underway to ship the movable shield from BNL to Oak Ridge.

Controls

Overcompensating for our absence over the holidays, controls spent considerable effort this week in support of operations, including the manning of overnight shifts. Meetings were held to develop strategies for addressing the many controls issues that came up during operations. Some requested improvements and bug fixes were made.

For example, several improvements were made to the MPS and timing systems this week. Some timing system improvements are shown in the accompanying shot of the timing master screen. In addition, a method was implemented for providing triggers to diagnostics even in the absence of beam and a problem that occurred when diagnostics IOCs were rebooted was fixed. Testing began on the support software for new RTDL input module.



Work continued on terminating RCCS field wiring for DTL tanks 1 – 3. A mock-up of a SC controls rack was also completed this week. This will allow LANL to install their equipment in the proper location before shipping. These racks are very full. Interface issues between the DTL vacuum PLCs and MPS are also being worked, and SCL MPS inputs are being laid out. The number of MPS chassis, cables, terminal blocks, and routing of signal cables will soon be known and documented, and this information will be useful during the upcoming ETC for WBS 1.9.

Documentation in advance of Ring and Target installation also proceeded apace. Three of four System Block Diagrams for ring controls was completed, as were the ring and target installation spreadsheets.

Loop testing of CF controls in the CHL and RF buildings was completed.

A new contract engineer, John Reed, has joined the Protection Systems team and will be responsible for PPS controls for DTL tank 3 conditioning. A separate system is being provided to control the RF system associated with this DTL. A new shielding and PPS configuration plan was developed to accommodate the evolving strategy for conditioning and commissioning DTL Tanks 1 and 3.

Work is continuing on the ODH system design. A sound survey was made of the LINAC and HEBT tunnels using an electronic horn. The horn was operated in the tunnel while sound measurements were made at several points. This survey will allow us to decide how many horns will be required to provide coverage in the tunnels. A similar survey was made in the CHL.

Testing is continuing on the new production Chipmunks. Temperature cycling testing conducted to date indicates that the new production units perform well during high humidity/ temperature cycling testing. The vendor has reported problems completing the remaining seven units however. Problems with the electrometer performance have prevented completion of the units. A trip is planned to the vendor next week to discuss measures to determine the nature of the problem.

Larry Hoff (BNL) traveled to ORNL to meet with controls personnel to discuss plans for the upcoming ETC, and to observe control system configuration and performance during MEBT commissioning. Observations made and conclusions drawn during the trip were submitted in a report. Larry was the “front line” controls interface while much of the ORNL team was on vacation.

Installation

Craft Snapshot 1/10/03

ASD craft workers	46.0
Foremen, ES&H, etc	8.5
Less WBS 1.9 controls	1.0
Less absent	1.0
TOTAL	52.5

An Earned Value Work Shop was held on Thursday, 1/09/03 with group leaders and lead engineers. The purpose of the workshop was to review basic Earned Value concepts and discuss in detail the ASD process for determining Earned Value for Davis Bacon Labor.

The ASD Friday Morning Weekly Installation Meeting has been expanded to include Operations. Operations will provide feedback on technical systems and planning for upcoming Maintenance Outages. The meeting was held in the Conventional Facilities trailers on site.

The Division Director's Weekly Installation Meeting updated the planning for accelerating Ring Installation and options for maximizing Earned Value in FY03. It was reported that the Ring Crane installation is projected to kick off on time, ~2/01/03, and be completed by 3/28/03. Water manifold modifications by the subcontractor will begin 2/01/03. Sealing of the Ring floor begins on 3/16/03.

A decision from the Project Office on Budget Authority to order cable tray and cable to support the accelerated schedule is expected soon.

DTL Tank #3 was installed in the tunnel on Wednesday, 1/08/03. Initial positioning by the Alignment Group was within approximately 1mm of the final coordinates.

Accelerator Physics

D. Jeon is investigating the impact of the prototype cryomodule tilted fields on the linac beam dynamics to evaluate its usefulness as a spare.

Most of the AP group is busy with Front-end commissioning. The major issue under investigation now is the ion source alignment and its connection with the MEBT trajectory and output emittance. As part of understanding the MEBT trajectory we have been using and debugging software for validating the BPM performance.

S. Kim is performing thermal analyses to evaluate the MEBT chopper target under fault conditions such as LEBT chopper failure.

The global coordinates for the RTBT, extraction dump and linac dump have been updated and sent to BNL for incorporation in the next revised lattice drawing.

Operations Group

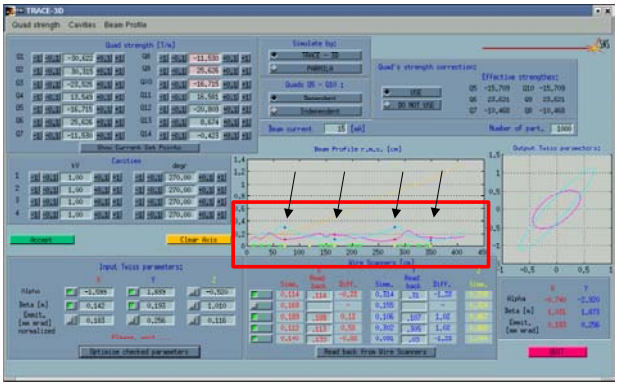
As stated in the last report, our goal was a beam that met the Project Execution Plan Milestone 1-B.6 requirements of a Beam Available to the Linac by the IPS date of 31-Dec-02. On December 30 the following a letter and attachment were attachment was submitted to the ASD Director as demonstration of that beam.

The following is the attachment from the submission:

"The SNS Parameter List, SNS Document number 100000000 PL0001 R08, page 3, contains a list of the Beam Evolution Parameters for the MEBT Beam, which is the beam exiting the Front End and entering the Drift Tube Linac (DTL). The expected normalized RMS Horizontal and Vertical emittances of the MEBT beam is 0.27 πmm mr.

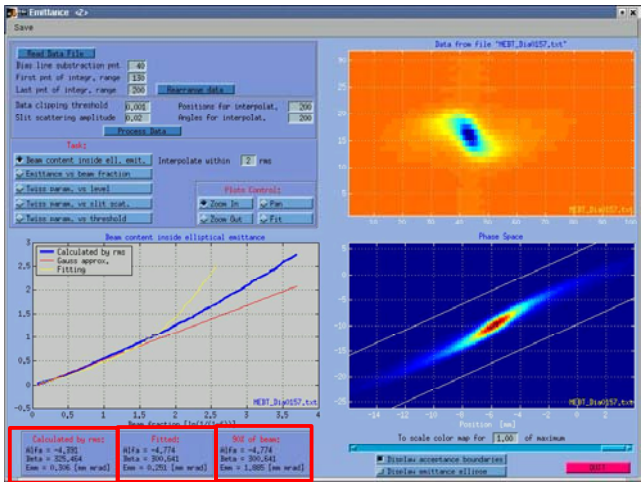
SNS Document 103000000 TD0198 R00 "Results of the Spallation Neutron Source (SNS) Front End Commissioning at Berkeley Laboratory", A. Ratti et. al. contains the results of commissioning studies done at Berkeley. The results presented for the re-commissioning at SNS are consistent with the Berkeley results.

During re-commissioning, beam profiles were measured at five locations in the MEBT, and the results compared with beam dynamics calculations. The following picture shows that deviations from the expected profile are quite small. The red box and the arrow indicate the relevant data points.

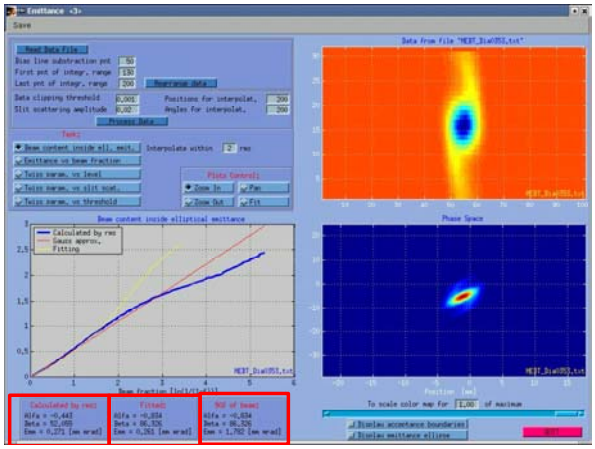


Following the wire scanner measurements, the Emittance Device was commissioned, and transverse emittance measurements were made in both the vertical and horizontal directions.

The following is the vertical emittance of the Front End beam operating at its nominal commissioning parameters: Energy = 2.5MeV, rebunchers at nominal power and phase-tuned settings. Again the red boxes show the measured data.



The following is the horizontal emittance of the Front End beam operating at its nominal commissioning parameters: Energy = 2.5MeV, rebunchers at nominal power and phase-tuned settings.



Emittances measured during SNS re-commissioning are consistent with those measured at Berkeley during commissioning.

Emittances were measured with peak currents varying from 18mA to 28mA peak current with no observable increase in emittance.

Beam was extracted from the Ion Source and transmitted to the beam stop at a maximum duty cycle of 5Hz x 1 msec.

Following the New Year holiday, the beam was re-established. Commissioning studies continue.

The control loops have been closed on the RFQ and the MEBT Rebunchers. Beam phase measurements were made for the rebunchers using the BPM amplitude as a diagnostic.

The Ion source position and angle have been optimized for transmission with minimal steering.

LEBT chopper studies are underway.

Ion Source Group

The Ion Source continues to work more or less as well as it did at LBNL. High voltage sparks and RF amplifier failures were the major cause of interruptions. After having removed the fast switch in the DTI supply, high voltage sparks are now more powerful, sufficient to perforate water hoses producing water leaks. Newly installed metal unions keep the water at 65 kV until it leaves the matching network, eliminating the prime cause of such leaks. Newly installed PVC shields sealed to the plastics standoff interrupted the path of surface flashovers, which turned out to be much more frequent than previously believed. These additions practically eliminated all high voltage discharges as well as the resulting RF-amplifier trips.

Martin Stockli attended the PAC'03 program committee meeting where he and Joe Sherman, LANL, organized the Sources and Injector sessions.

Mechanical Group

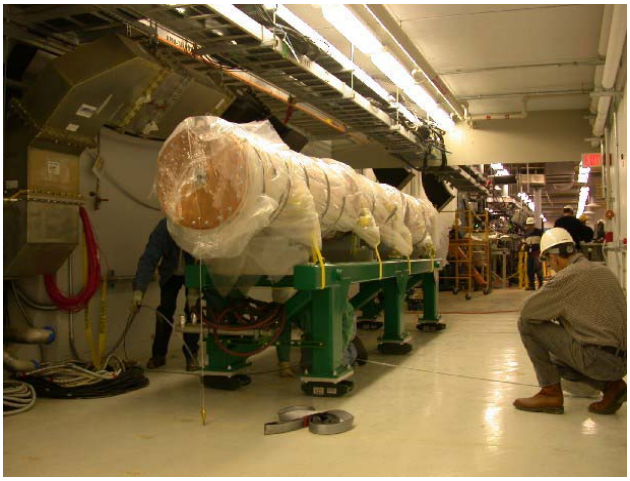
DTL-3 was moved from the RATS building to the tunnel and anchored in place on Thursday, Jan. 10. The move went smoothly from start to finish. The cooling manifolds mounted on the support frame were removed for the move and will be reinstalled next week.

DTL-3 at the FE Building


DTL-3 on a truck in the FE Building

Unloading DTL-3 at the FE Building

Rolling DTL-3 to the Tunnel



Final Positioning in the Tunnel

Magnet Systems

Linac HPRF

Closed the loop for the RFQ-RF.

QEI engineer was here to work on rebuncher cavity RF systems; we now have 4 working power amplifiers and one spare system working to about 3/4 power, due to weak solid-state amplifier. The other spare system is not working due to solid-state amplifier being kaput.

Both LEBT chopper power supplies were sent back to factory for repairs, problems to extensive for us to repair, we due not have schematics, not provided by Berkeley.

Representatives from Marconi replaced the spacer disks that support the inner-conductor on the 402.5 MHz klystron output coupler on all four delivered klystrons. They found the inner-conductors were between 2-4 mm too long and had stressed the spacers beyond their elastic limits. This spacer caused arcing on the RFQ klystron and had previously been replaced. An upgrade to make the inner and outer conductors coplanar will be made to all Marconi klystrons. The RFQ klystron will continue to operate as is through January 2003.

Waveguide installation in the RFTF complete, two more days needed to finish heliax cable pulls for LLRF systems. Pipe fitters to start piping transmitter cooling cart to technical equipment, next week.

Piper fitters continue piping transmitter 3 & 4 cooling cart to technical RF equipment. Transmitter cables for 3 & 4 pulled, LLRF cables still need pulling.

Isolated problem with one of two LEBT Chopper pulsers to HV gate drive circuitry and returned units to factory for repair. Updated screens on HVCM PanelView display. Received final parts for fabrication of optical pulse coincidence detector for IGBTs. Began checkout procedure for MEBT Chopper power supplies.

Linac LLRF

10 Jan 03

ORNL

FE Commissioning Support
The RFQ was operated with feedback control for the first time on Tuesday, Jan. 7. Sasha was quite pleased with the resulting improvement in beam quality. RFQ LLRF studies were performed Friday evening, Jan. 10. Amplitude and phase regulation were measured under openloop and closedloop conditions. The measurement results are in the electronic logbook. These initial results are encouraging with regard to the regulation requirements of ±1% and ±1deg. More performance characterization on the RFQ and the MEBT rebunchers will be carried out as the commissioning schedule permits.

One of the MEBT LLRF controllers failed this week. It appears the 2.5 MHz input to the FPGA is damaged. A replacement digital board from LBNL is due at Oak Ridge Jan. 11.

There is ongoing work to improve the operator interface to the LLRF control system.

Reference System
The 402.5 MHz reference line will be installed in the linac tunnel in time to support the DTL1 and DTL3 testing and commissioning. Existing 3-1/8 inch rigid line, presently in RATS2, will be reused. Installation will begin as soon as possible, depending on FE commissioning and other installation activities near DTL3. A vendor quote on a complete frequency reference source is expected in the next week. The team has been refining the source requirements document and issued a draft document on performance considerations.

Design Review Report
The reviewers for the Dec. 17 hardware design review have given us their written comments. We will provide a written response by Jan. 24.

FPGA Code Development
The LBNL Verilog FPGA code is being ported to the Vertex II FPGA that will be used on the new Digital Front End under development at LANL.

Management
The project office has our Estimate to Complete and project plan. The plan and ETC will back up a funding PCR to be released later this month.

LANL

Accomplishments: (1) Work continues on producing Rev 0 of the new hardware platform. The schedule is still being met, specifically: (a) Latest Analog Front-end (AFE) specifications were sent to the vendor and an order was placed for engineering design and two prototype units. We expect delivery of prototypes in early March. (b) Digital Front-end (DFE) schematic design was delivered to our ECAD group who have started board layout. Design will be frozen Jan 17, followed by a formal review. We contacted the manufacturer and have reserved a production time slot. We are reviewing the Q/A process for the board and Mark Prokop will visit the vendor next week to discuss. (c) RF Output module schematic is under development and will be sent out to ECAD for board layout in one week. The long lead items (*e.g.,* output filters) were ordered. (d) Motherboard schematic capture will start in two weeks. Schedule is tight but remains consistent with receiving the first prototype platform in mid-March. (2) Three Rev-D High-Power Protect Modules (HPM) are expected from manufacturer next week. Follow two weeks of testing, they will be shipped to SNS for DTL installation. We now have three HPM test stands for testing the new boards. Two will be shipped to ORNL as a part of LLRF test stands for SNS. (3) Following the Dec design review, the firmware for the new LLRF system will be based on the LBNL firmware. An interface control document (ICD) is being developed to completely specify the firmware specifications including interface between the hardware, firmware and software. This will be the blueprint for adapting the LBNL firmware to the new board as well as adding the extra functionality. LANL staff will travel to LBNL next week to: (a) review current Verilog code in detail; (b) review outline for FPGA specifications; and (c) review changes required for porting to new board. (4) We installed the EPICS and user interface screen on the LBNL LLRF system at LANL. This will be our test bench for understanding the Berkeley system and for adding new functionality. (5) LANL, ORNL and LBNL went through an Estimate to Complete exercise and developed a 3-year budget and schedule to be entered into the Primavera system. This will be finalized in Jan.

Concerns & Actions: (1) Ability of vendor to meet the AFE specs. As this design is built closely upon the BPM AFE, test of the new BPM boards will provide an indication of feasibility of meeting the requirements. (2) Technical specifications are still not firm and this will affect the final hardware and firmware design. (3) We are getting somewhat closer to finding the right VHDL expert. This needs to be finalized this month. (4) Current spending pattern is projecting a $770K overrun in FY03. Cost containment measures on staffing and procurement are being implemented.

LBNL

We have received the clean-up rev of the digital board we made at the end of the year. This addresses all issues found while bench commissioning the RFQ backup system. We also have a complete parts list for this board, and quotes from three vendors. Therefore, we are starting the procurement of all parts to make ten more boards.

There is an additional delay in the delivery of the 805 filters needed for the JLAB test. The vendor RLC claims to have encountered manufacturing problems in the plating of some parts, and that such problems have been fully solved. As a result, they plan to ship on Monday 1/13. We will monitor this closely as the parts are needed by the end of the month. In general, we are ready to support the beginning of the JLAB system installation on Jan 27.

The firmware development continued as well. Larry has tested successfully the DDS part of the algorithm and discussed this with Amy during her visit.

We also started to setup Matlab, and are beginning to analyze the code from LANL, as well as converting the C-model to Matlab. Some problems are still being addressed with the installation of Matlab/Simulink on multiple platforms.

Due to the problems with one of the MEBT systems at ORNL, we have prepared a replacement digital board that will be shipped later today and should arrive to ORNL on Saturday 1/11.

20 Dec 02

ORNL

Commissioning Support

The Oak Ridge LLRF team worked shifts the weekend of 14-15 December in support of Front End beam commissioning. RF calibrations and preparation of the MEBT RF systems were carried out in parallel with RFQ operations. Mark Crofford and Chip Piller conducted four LLRF training classes for operators this week. LLRF EPICS operator screens are under development.

The RFQ was routinely operated at 750 kW RF and all four MEBT cavities have been operated at 5+ kW RF with beam. All LLRF systems have been calibrated and are stable. Radiation Safety has cleared the RFQ and all MEBT systems for operation under present maximum operating conditions.

MEBT
The MEBT tuners are now operational. The autotune function does not work properly on a couple of cavities that also show higher levels of reflected power. We believe that this may be due to cavity drive loop coupling mismatch and plan to measure and correct as necessary. LLRF calibrations were performed for all four MEBT systems. MEBT systems were operated at maximum values (up to 17 kW) for radiation safety checkout.

RF Test Facility
The installation of the LLRF system for the RF Test Facility began. The VXI crate, an oscilloscope and power outlets were installed in the LLRF racks. The interface chassis is ~80% complete; cabling, the RF source, and Ethernet are still required to complete the installation.

Miscellaneous
Mark Crofford prepared a Master Oscillator specifications document that was circulated for comment.

Reviews & Meetings
The first design review of the new Field Control Module was held at LANL on December 17. The review was attended by all but one of the LLRF Advisory Board members. Larry Doolittle, Curt Hovator, and Chris Ziomek served as reviewers. The Team looks forward to their written report and will follow up with a written response to the report.

A meeting on software and FPGA coding was held at LANL on December 18. The primary result of this meeting is that the Team agreed to make use of the LBNL FPGA code to the extend possible as a starting point for the new system. Further information is contained in the LANL section of this report.

Management
Champion, Ratti and Shoaee worked on the Estimate to Complete and detailed project plan on December 19. We reached agreement on a LLRF budget through FY2005. This will be the basis for a funding PCR that will be submitted by mid January.

LANL

New Hardware Platform
Work continues on the design of the new hardware platform for the LLRF system. The system consists of four modules:

a) The Analog Front-end. This is an upgrade of the front-end for the SNS diagnostics system. Requirements for the new module were collected and transmitted to Bergoz of France. We expect a delivery of two prototype units early in March.

b) The Digital Front-end. This is the computation engine of the LLRF system and is also an upgrade of the SNS diagnostics board. We are currently working on the schematic capture of the design and building parts library in our CAD group.
c) The RF Output. This module provides the drive signal to the klystron and is currently being designed.
d) The Motherboard.

The above four boards are expected to go into fabrication and assembly February 24 and with a lead-time of three weeks, we expect the first prototype platform in the middle of March.
The team also produced a detailed platform specification.

HPM

- Mark Champion requested that we implement the chatter fault detection in the VXI IOC. This was done and installed in SNS IOC for use during the RFQ conditioning and possibly longer.
- We have been asked to investigate what it would take to improve the time response of the HPM to one microsecond or better. Initial investigation indicates a redesign of the HPM using faster ADCs and buffer amplifiers. It would also require modifications to the PLD code to drive the new chips and to decimate the data stream to the history buffers. The redesign is expected to take about two months. [It has not yet been decided whether or not to carry out this redesign.]

Applications Firmware and Software
The team completed the documentation of the required FPGA application firmware. These included a phased implementation list of applications. Detailed specification for each module, data flow diagrams, interface definition and signal processing documents.

Work was also done on a simulated resonance control scenario that included performing the correction on a VME IOC (via EPICS) rather than on the LLRF digital board. The results support the feasibility of this approach even in the case that each IOC supports three LLRF systems, as is proposed for the SRF Linac.

Modeling and Simulation
An LLRF modeling and simulation meeting was held at LBNL on December 12-13. The goal of the meeting, which was attended by experts from ORNL, LBNL, and LANL, was to take an inventory of the modeling work done for the SNS LLRF control purpose and to compare and contrast the work at LBNL and LANL. At this meeting we transferred to Berkeley the Field control MATLAB model (including the PI controller and iterative learning controller) together with an 85-page document. For the resonance control model, the c-code for the previous DSP TMS320C6203 was made available.

Sung-il explained the features of his MATLAB modeling including analysis and synthesis tools such as FFT, Power Spectrum, frequency domain amplitude response /phase response calculations, system identification tool, nonlinear control design tools, filter design tools, time domain simulations, fixed point blocksets, Xilinx FPGA blocksets, memory (RAM, ROM, FIFO, Dual Port RAM), etc. Subsequently the three labs agreed to adopt LANL modeling and simulation as the basis for the entire SNS LLRF effort.

LLRF High Level Architecture Review & Applications Workshop
A review was held on December 17 at LANL to review the new hardware platform architecture. A workshop on the implementation, testing and validation of applications firmware was held the following day, December 18.

The reviewers (from ORNL, LBNL, JLAB, LANL, Ztech) made a number of comments for improvement on the design details. However the overall approach was approved and we will proceed to board layout as mentioned above.

At the applications workshop meeting, LANL agreed to base their applications development on the Berkeley system and to try to transfer as much of the existing system as possible to the new platform. We will develop the new FPGA design specifications and add the missing functionality to the Berkeley applications. The collaboration will also develop a test and validation structure for the whole system.

LLRF ETC
LANL, ORNL and LBNL went through an ETC exercise and developed a three year budget and schedule to be entered in the Primavera system later. This will be finalized by mid January.

LBNL LLRF Hardware at LANL
On December 18 Berkeley delivered a Rev B unit of their LLRF system. The system was connected to LANL's 402.5 test cavity and an amplifier (emulating a klystron) by Sung-il Kwon, Kay Kasemir and Larry Doolittle. They subsequently managed to demonstrate field and amplitude control of the lab setup.

LANL engineers will use this system to study and learn the LBNL LLRF applications firmware and software. It will also provide them with a fully functioning platform for developing and testing new algorithms.

Visit to the NIS Division to recruit FPGA development engineers
On December 10 members of the LLRF team at LANL visited two engineering groups at the NIS division to seek assistance for the development of the LLRF FPGA application firmware. These groups specialize in developing high performance digital systems for deployment on satellites. The LLRF team presented a technical summary of the project including the specific areas where we are soliciting support. Our goal is to bring onboard early in January an experienced FPGA firmware engineer to assist with the design of the application architecture.

The NIS-3 group leader has identified a number of engineers who are interested in contributing to this project and we will follow up on that during the week of January 6.

Electrical Systems Group

Attempts have been made to track down the cause of the high frequency oscillations seen in the Front End MEBT steerer power supplies. These oscillations have no effect on the beam steering (~ 1 MHz - damped out as eddy currents in steering magnets), but cause noise interference with the diagnostics BCMs. Problem has been traced to loading of the power supply readback by the control system ADC - this disrupts the control loop and causes power supply instability. We are discussing the proper fix to this problem with the controls group.

The Front End MEBT Quad power supplies have insufficient rack cooling – the power supply chassis are operating at temperatures of over 130 degrees F, which will reduce the MTBF of these supplies. Additional cooling fans need to be added to the rack. Engineering design of rack changes has commenced.

A problem affecting reliability in the Linac and Ring corrector supplies was discovered by the vendor. Two transistors and one capacitor in each supply do not have the contract specified voltage safety margin of 100%. The repair of these supplies is being negotiated - 200 of 360 supplies have been shipped to SNS. The repair will most likely be performed at SNS by vendor personnel.

The group prepared and updated plans to accelerate ring installation in FY03.

Survey and Alignment Group

Cryogenics Group

Beam Diagnostics

ORNL Beam Diagnostic Report:
SCL Laser Profile Monitor Tests on the MEBT:
All parts (mechanical, optics, software) are at hand for installation on the MEBT. Dan Stout and Kerry Potter will oversee the hardware installation on Thursday.
Laser-wire electronics: A number of electronics are designed and built for this test by Jim Pogge and Craig Deibele.
Laser-wire optics: We hope to use the long weekend (1/18/03 to 20th) to align the optics and get ready for profile measurements.

Laser-wire Software: Top level VI, data storage/retrieval, analysis, menus for data display/settings adjustment etc are prepared by Wim Blokland and Matthew Stedinger. The software supports the slow acquisition on the electron collector and the fast acquisition on one or two BCMs.
Commissioning: We setup NTP clients on all PCs to provide data with timestamps within 200msec to the users. This is a short-term solution to RTDL. Wim and Ernest setup beacons for diagnostic data archiver. Andy, Craig and Jim worked on troubleshooting the BCM CPU before sending it back to BNL for diagnosing the failure.
Timing: Craig Swanson continues work on the two final versions of the diagnostic timing cards. Both PCI Universal board and CardBus board are being manufactured now and should be back next Thursday.

LANL Beam Diagnostic Report:
BPM electronics: We have received 8 ea. next-generation 805-MHz Analog Front Ends (AFEs). Initial test results look encouraging. Work continues on the new PCI motherboard. The schematic is complete and component layout is in progress. The digital front end (DFE) ECAD work is also in progress. The timing daughter card ECAD work will begin upon the completion of the PCI motherboard work. New PC chassis have been ordered for the D-plate BPMs. These PCs are 2U in height, and will accommodate two PCI cards - one for the processor, and one for the RTDL/Event Link card. Front-end commissioners at ORNL have observed considerable phase noise on the BPM system. The fast majority of this noise appears to be due to the 2.5 MHz reference supplied to the BPM system, and not due to the BPM system itself.
WS actuators: Work continues to prepare the actuators for DTL-1 and the D-plate.
WS electronics: We have received the two PC boards needed for the DTL-1 and D-plate units, and they are now being stuffed.
ED/FC actuators: We have received the DTL-1 and D-plate units from the vendor. Remaining work includes the electrical wiring, attaching the vacuum feedthroughs for the electrical connections, and testing the full assemblies.
ED/FC electronics: Assembly is complete for the first unit. It must now be connected to a PC with the NI-6110 PCI card, and the associated LabView code must be written.
D-plate: We received the view screen actuator from the vendor. Like the ED/FC units, some wiring is necessary to complete the unit. The halo scraper electronics chassis is complete and ready to be tested with a PC. Work continues to prepare the slit and harp actuators. Fabrication is in progress on the Macor replacement parts for the beam stop o-ring and halo scraper segment supports. A member of the beam diagnostics team will travel to ORNL next week to install water-cooling hoses, water fittings, and the steering magnet.

BNL Beam Diagnostic Report:
General: Group members are beginning preparations for the upcoming design review
1.5.7.1 BPM
Assembling 4 more 26cm BPMs for the vacuum group.
Shop has started to fabricate the six additional 30cm BPMs for the spare vacuum chambers.
BPM base-band PCB artwork is complete. PO for board construction complete. Arrangements have been made to expedite parts population. Parts are kitted and ready for shipment.
Preparing schematics for the RF/mixer section. Refining calibration section.
1.5.7.2 IPM
Detailed design of detector and vacuum chamber continues.
Burle Electrogen Electron Generator array calibration source was ordered. This is a microchannel plate in which the input channels are doped for greatly decreased work function. A modest bias voltage causes the MCP to emit a very uniform cold electron beam, which uniformly illuminates the detector MCP. This will give us the capability to monitor MCP aging accurately with no moving parts.
Awaiting project approval for electromagnets
1.5.7.3 BLM.
Awaiting further input from project office on single/dual path question.
Continue with 8-channel AFE module PCB design. Ordered parts for AFE chassis, and selecting Euro-card module and internal chassis components.
Assembly of the 8-channel AFE module test box and design of testing fixture for the AFE continues.
Preparing to order bulkhead connectors and cable ends, awaiting imminent delivery of 10 LND (new ION chamber design) and 15 end-cap RC network PCBs.
1.5.7.4 BCM

Failure of MEBT BCM electronics appears to have resulted from application of high voltage to the signal input. Trying to understand how this might have happened. IFE has been repaired, and preparations are in progress to ship it back to ORNL.
Moving ahead with completion and testing of two boards earmarked for DTL commissioning to provide MEBT spares, ordered additional DAC2902 evaluation kits to act as temporary calibrators.
In preparation for BCM electronics deliveries, parts kits are being prepared to populate 4 more boards. This will provide for three systems (six toroids) and a spare.
Updating schematic to include replacements for parts that have become obsolete, new artwork rev is underway.
Tests have been made on the BCM software to determine the time required to process a single channel including calibration and time constant calculations for each analysis. This came to a 5 Hz rate under normal Labview configuration. When operated so as to be uninterruptible, the system can operate at 10Hz (but it can not be stopped except by shut-down of power).
Placed order for the ceramic breaks and flanges for the HEBT BCMs.
Went over mechanical design of HEBT BCM with cognizant ME, suggested changes
1.5.7.5 Tune
Detailed design of kickers is proceeding, continued communication with Meggitt Systems to get a quote on the feedthroughs, received quote from Cablewave for the mating connectors.
1.5.7.6a Carbon Wire Scanner
Finished updating drawings for the MEBT wire scanner.
Requested design group to produce official drawings for the HEBT WS beam box assembly.
Placed the order of the WS beam boxes and associated flanges in the HEBT line.
1.5.7.7 Beam-in-Gap
Worked with vacuum group to claim space for the BIG and the Tune Kicker at the extraction and collimator area in the Ring, modifying the preliminary layout according to comments of the vacuum group, contacted AP to confirm the beam pipe apertures at the Ring straight sections.